homology. It is utterly unphilosphocal to accept without the clearest proof such a structural modification as this change in position of the mandibles would require, and the modification of the ordinary labium into a beak of this character is a process that ought to be proven. It seems to be assumed that the "labium" of the hemiptera is the same as the "labium" of the diptera, e. g. *Culex*, and if this is so, I have a paper now in press, in which I claim to prove that this "labium" in the diptera is really only a modified galea, or a maxillary structure. I hope to prove some time in the future, when I can get the necessary material, how this modification of the hemipterous mouth came about, and that the mandibles do not, habitually, become internal mouth structures so long as there are other organs enough more naturally situated.

EXPLANATION TO BASE FIGURES.

Fig. 1. *Siphonophora avenae*. *a*, beak; *b*, bristles of mouth—"mandibles" and "maxillae;" *c*, antenna of winged viviparous female.

Fig. 2. *Aphis brassicae*. *a*, antenna of wingless forms; *b*, antenna of winged viviparous female; *c*, beak of young lice; *d*, beak of mature, winged form.

Fig. 3. *Aphis cucumeris*. *a*, antenna of winged viviparous female; *b*, beak of wingless forms.

Fig. 4. *Myzus cerasi*. *a*, 3rd; *b*. 5th; *c*, 6th joint of antenna of winged viviparous female.

Fig. 5. *Aphis persicae-niger*. *a*, antenna of immature forms, joints 5 and 6; *b*, 3rd; *c*, 4th; *d*, 5th; *e*, 6th joint of antenna of winged viviparous female; *f*, sensory pit from front; *g*, same from side.

NOTES ON TWO SPECIES OF DATANA WITH DESCRIPTIONS OF THEIR LARVAL STAGES.

BY HARRISON G. DYAR, RHINEBECK, N. Y.

Of all the closely related species of this genus, the two which approach each other the most nearly and are most difficult to distinguish in the imago state, are *D. major* and *D. drexelii*. I have elsewhere called attention to the main feature by which they are to be distinguished, which, after all, is only a matter of degree of coloration. The species differ, or rather tend to differ, in other points beside the brightness of the costal shade, namely, in the more entire outer margin of the primaries, and the darker more even coloration of the wings of *D. major*.

The size is the same in both species, there are no markedly distinctive male genital characters, and the lines and

spots are arranged in the same manner; in fact, there is no absolutely constant difference, either in structure, markings or coloration, between the two so far as I have been able to observe, and I have no doubt that specimens may occasionally occur which it would not be possible to refer positively to one species or the other by an examination of the imago alone. It would at first seem that these species must be more closely related than others in the genus, perhaps hardly yet distinct; but when we consider the larval stages, it is at once apparent that they are widely separated, more widely, in fact, than many other species of *Datana* which are readily separable in the imago state. This difference would seem to indicate rather a long inherited similarity between the moths than very recent derivation from a common ancestor. While the moths, it may be, have remained constant to their former type, or undergone a similar development, the larvae have diverged greatly, which would seem to correspond to the general rule in lepidoptera, that the larvae are often the first to vary. The eggs of *D. major* and *D. drexelii* differ markedly: the larval differences appear in the first stage and are kept up and intensified throughout the larval period, and only when the pupa stage is reached, does the close resemblance observed in the moths begin. The cause of the divergence in the larvae, especially at maturity, is not very obvious, particularly in the peculiar ornamentation of *D. major*, which differs from that of all of the other *Datana* larvae so far known.

D. drexelii is abnormal only in the predominance of yellow about the prothoracic and the 8th, 9th and 10th abdominal segments,* and this might serve as an excellent protection, in that the bunches of yellow striped larvae with their extremities elevated in their customary position, resemble the little clusters of flowers of the Witch-Hazel with their linear yellow petals, which begin to blossom in September, just as the larvae become conspicuous. What protection, if any, their coloration affords on the Deerberry, their other food-plant, I am unable to say, as they occur almost exclusively on the Witch-Hazel in this vicinity. (Rhinebeck, N. Y.)

But as to *D. major* its curious spots do not resemble anything so far as I can see. It is to be noted, however, that the habits of the two species differ, for while *D. drexelii* are always gregarious, *D. major*, when they do not separate entirely, feed farther apart, and tend to scatter more in the last stage than almost any other species, and the change in ornamentation from lines to spots, which they undergo in the last molt, may be of use to them with their changed habits.

DATANA MAJOR,. *G. & R.*

Egg. Sub-pyriform, of less diameter and cylindrical for a short distance at the top, recalling the structure of *D. palmii;* flattened at base or a little hollowed; evenly flat on top with a sharp angle between top and sides. Color uniform sublustrous white, a rather

* In this article, I have followed the nomenclature used by Dr. Packard for the larval segments, as it is not possible to describe intelligently the markings of *Datana* by the usual method.

large central black spot, larger than the corresponding one in *D. drexelii*. Greatest diameter 1.1 mm.; at the top .7 mm.; height .7 mm. Laid in groups of from 90 to 100 on the underside of a leaf of the food-plant.

First stage. Head rounded, black, shiny; width .5 mm. Cervical shield, anal plate, thoracic and anal feet and the abdominal feet outwardly, black. Body, wine red, a very broad subdorsal and lateral yellowish band nearly entirely replacing the ground color, and each bisected by a narrow red line. Venter without marks. A number of hairs growing from minute dark brown warts. These warts are proportionally larger in this stage than in any subsequent one. Hairs also arise from the cervical shield and anal feet. The larvae at this stage eat the parenchyma of the leaf from above, and when not feeding, rest on the lower surface or on the stems.

Second stage. Head rounded, rather higher than wide; shiny black, or with a slight brownish tinge; width 1.1 mm. Body dark wine red, the two pale greenish yellow bands on each side as before, very wide, nearly or quite lacking their central lines, so that all that is left of the ground color above is a narrow dorsal and subdorsal line. Venter wine red with a central narrow pale yellow line. The hairs from the cervical shield are long, the others short, arising from minute warts. As the stage advances, the lateral bands become somewhat more distinctly divided by the ground color and almost white, though still possessing a yellow tinge. During this stage and subsequently the larvae eat the whole leaf.

Third stage. Head higher than wide, narrowing a little toward the vertex, depressed at the sutures. Color sordid orange, becoming red-brown, the ocelli and mouth parts black. Width 1.6 mm. Cervical shield black or partly orange; feet and anal plate black, shiny. Body blackish brown, the stripes as before, yellowish white faintly bisected by a fine line of the ground color. Venter blackish vinous, with traces, more or less distinct, of a central white line. Bases of legs and corresponding spots on the apodous segments dark wine red, or orange tinted. Spiracles and the minute piliferous tubercles, black. Hair sordid white, short, but a few long ones overhang the head. As in the previous stage, the lines bisecting the lateral bands become more distinct with advancing growth, the ground color becomes darker, and the bands clear white. In many examples, a subventral line interrupted by the bases of the legs and a central ventral line are to be seen.

Fourth stage. Head as before, brownish red becoming darker; the mouth parts, antennae and ocelli, black; width 3.1 mm. Body black, with four lateral clear white stripes on each side, much broader than the intervening spaces, and three narrow ventral lines represented in some examples by a few linear dots only. Cervical shield light brown, anal plate black or partly brown, thoracic and anal feet and the abdominal feet outwardly black; bases of legs and

corresponding spots on the legless segments brownish red. Hair white, thin, longest at the extremities, the minute tubercles black. The lateral bands are not confluent at either extremity, though in some examples, there is a tendency for the third and fourth lateral (above and before the spiracles) to run together in the middle of the body.

Fifth stage. Immediately after molting before the colors have become fixed, the stripes are continuous as in the previous stage, but in a few hours the characteristic markings of this stage are assumed. Head as high as wide, rounded, shagreened, shiny; clypeus wrinkled and depressed in several places, principally along the upper part of the sutures; labrum wrinkled. Color, orange-brown to almost mahogany red; ocelli black, antennae and palpi ringed with black and white, their bases red; mandibles black, white inwardly; maxillae black. A few hairs sparsely distributed. Width 5.3 mm. Cervical shield, anal plate, bases of all the legs, and corresponding on the apodous segments (i.e. on the first, second, seventh and eighth, but *not* on the ninth, abdominal segments) mahogany red, the thoracic feet black, the abdominal orange brown, in some examples a little blackish outwardly. Body black, the ventral lines absent or represented by a few elongated dots, the lateral bands broken into rows of sub-quadrate spots, as I have elsewhere described.* This "serial atrophy" occurs in the following manner: — the three upper lateral stripes on each side are broken in each segmental suture and more or less broadly through the centre of the segment, the third lateral band (superstigmatal) less broadly than the others. The fourth lateral (substigmatal), the subventral, interrupted by the bases of the legs, and the central ventral (these last two are represented only by dots) are broken twice on each segment, once just before the spiracles and again toward the posterior edge of the segment, but are not broken in the sutures. In some examples, the posterior white spot of the third lateral band is again narrowly broken, and the bisegmental spot of the fourth row very narrowly in the sutures. The stigmatal spot of this row, when large, is apt to be broken at the spiracles. On the prothoracic segment, the two upper bands are represented by a white dot behind the cervical shield; the third, by a rectangular spot above the spiracle; the fourth by the bisegmental spot. On the ninth abdominal segment, the first row has a sub-quadrate spot, in some, followed by a dot; the second, a rectangular spot scarcely bisected, the third and fourth are normal. The tenth abdominal has only a dot representing the third lateral band, and the bisegmental spot representing the fourth. The subventral lines are represented by dots between each segment from the third to the eighth abdominal, and the ventral, by the bisegmental dots and a dot anterior to the bases of the legs on the second to the sixth abdominal segments.

* Can. ent., v. 21., p. 34.

Spiracles velvety black. Hair white, rather long, beside numerous fine, short black hairs, all growing from minute black tubercles. Length of larva at maturity 60 mm. The form of this larva with canary yellow bands and spots did not occur in any of the examples from which these notes were made (a brood of 55 and another large brood observed in the field). I have formerly found a few yellow ones among a brood of white spotted *D. major*, and occasionally a brood entirely yellow. Though the difference in coloration is very marked between the two forms, it is evidently, from its mode of occurrence, only a variation. A similar variation occurs in *D. palmii* * and less markedly in *D. contracta*.

Pupa. Formed in a subterraneous cell. In shape it is robust, cylindrical, thickest centrally, and rounded to the head; cases distinct; a slight creased elevation between the eyes. Abdominal segments slightly tapering: cremasters, two, very short, not well separated, each with three spines, the posterior one the longest, but often two, or partly aborted. Cases creased, body coarsely punctured, very finely in the movable sutures. Color dark or blackish mahogany. Length 25 mm., width 9 mm. This stage lasts through the winter and the species is single brooded. The duration of the larval stages was as follows: — 1st stage, not observed, but probably about five days; 2nd stage, 6 days; 3rd stage, 8 days; 4th stage, 9 days.

Food-plant: *Andromeda ligustrina*.

Larvæ from Ulster Co., N. Y.

Datana drexelii, *Hy. Edw.*

Egg. On the type of *D. ministra*. Subcylindrical, of a little greater diameter near the bottom than near the top; vertex rounded; base nearly flat. Color shiny whitish, the circular lid-like top very white and shiny, with a central small round black spot. Diameter .7 mm. In hatching, the larva eats away the lid, and emerges from the hole thus formed.

First stage. Head rounded, black, shiny; width .5 mm. When newly hatched, the larva is scarcely distinguishable from *D. major*. The anal feet are rather long and elevated. Body sordid yellow, cervical shield, anal plate and feet, blackish. A number of short hairs from the head and from about six rows of small blackish tubercles which are larger in proportion than in the subsequent stages. As the stage advances, the body becomes reddish with four lateral stripes on each side and three ventral, about as wide as the intervening spaces, dull yellow and confluent posteriorly. During this stage, the larvae eat the parenchyma in the same manner as *D. major*. I have estimated that a single larva eats about 90 sq. mm. of Witch-Hazel leaf.

Second stage. Head black and shiny with a few hairs, width 1.1 mm. Body brown, stripes dull yellow, narrower than the intervening spaces, extending

* I would like to call attention to the relationship that evidently exists between *D. palmii* and *D. major*. They are alike in egg structure, in the feature of bicolorous larval hairs (which does not occur in any other species to my knowledge), in coloration of head and lines and in the slightly scalloped forewings of the moth.

from the cervical shield and the anterior edge of the prothoracic segment to the anal plate and becoming a little confluent there. Cervical shield, anal plate, thoracic and anal feet and the abdominal feet outwardly black. Hair short and pale. During this stage, the larvae eat the whole leaf.

Third stage. Head higher than wide, depressed at the sutures of the clypeus: smooth shiny black, width 1.8 mm. Body brown, the stripes yellow, confluent posteriorly and along the anterior edge of the prothoracic segment. Otherwise as in the previous stage.

Fourth stage. Head shaped as before, smooth; centrally depressed at the top of the clypeus and more slightly along the central suture: clypeus and labrum wrinkled; all shining black; width 3.2 mm. Cervical shield black or partly brown, in some examples nearly all light brown; anal plate, thoracic feet and the abdominal feet outwardly, black. Body black or partly brown, the anterior half of the prothoracic segment yellow, the stripes strongly confluent on the last segment. The bases of the legs and corresponding spots on the legless segments, as in the mature larva, of a darker yellow than the lines. Each segment is shaded centrally with this yellow, but it does not cause the lines to appear confluent on account of its darker shade. Hair sordid white beside other short fine brownish hair seen with a lens.

Fifth stage. Head as high as wide, flattened in front, depressed at the upper part of the sutures of the clypeus, punctured. Clypeus and labrum somewhat wrinkled. Color shiny black, the antennae and palpi white-ringed, their bases greenish. Width 5.4 mm. Body black, cervical shield honey yellow, anal plate, thoracic and anal feet and the abdominal feet outwardly, black. Anterior half of the prothoracic segment yellow; stripes narrower than the spaces, citron yellow, running into the yellow part of the prothoracic segment and confluent posteriorly on the tenth abdominal, which is all yellow except the anal plate and a dorsal band. The three upper lateral lines are connected also on the eighth and ninth abdominal segments by a broad dark yellow shade. The bases of the legs and corresponding spots on the apodous segments (on the first, second, and seventh, eighth and ninth abdominal segments) also dark yellow, forming expansions of the subventral line and reaching the lowest lateral line, except on the thoracic segments and the ninth abdominal. On the apodous segments in the centre of each yellow patch, is a small black spot, representing the absent legs, but this is not present in all examples. Hair rather abundant, sordid white, the long and short hairs concolorous, arising from minute blackish tubercles which, in the black parts of the body, are each surrounded by a minute yellow ring.

Pupa. Exactly like that of *D. major;* the two cremasters each bear three spines in a transverse row, the posterior one the longest. Length 28 mm; width 10 mm.

Single brooded, the winter being passed in the pupa state beneath the

ground. The duration of the larval stages was as follows.— 1st stage, 5 days; 2nd stage, 6 days; 3rd stage, 6 days, 4th stage, 7 days; 5th stage, 7 days.

FOOD-PLANTS: *Hamamelis virginica*, *Vaccinium stamineum*.

Larvae from Ulster Co., N. Y.

THE NUMBER OF MOLTS OF LEPIDOPTEROUS LARVAE.

BY HARRISON G. DYAR, RHINEBECK, N. Y.

Two articles have already appeared in PSYCHE on this subject * and it is evident from a perusal of them that considerable confusion exists as to the number of molts of certain species. In this article I propose to establish a criterion by which different observations may be compared and errors detected. for it is no difficult thing to overlook a molt or even to think one has occurred when it has not.

It will be seen by an examination of the following figures that the widths of the head of a larva in its successive stages follow a regular geometrical progression, and if, in examining the measurements of heads taken in following out a life history, any deviation from the calculated progression is shown, it is evidence that an error has been committed or that the larva has behaved in an abnormal manner; but the latter case can readily be distinguished from the former if a moderate degree of care has been exercised in taking the measurements. Hence, if two sets of observations show a different number of stages for the same insect but each follows its own progression. we may conclude that this variation is actual; but if either set shows a lack of regular progression that one we must regard with suspicion. Corroborative observations of the kind indicated are to be desired and until we have them we can not speak with confidence about the number of molts of any species. I recommend that all who hereafter describe larval stages give the width of the head for each stage. I have selected the *head* as the part not subject to growth during the stage, and its *width* as the most convenient measurement to take.

In the following I give first the calculated widths of head under each species, with the ratio, followed by those that were actually found. All measurements are in millimeters and may be considered accurate to within .1 mm. Certain irregularities are commented upon in the notes to which the small numbers refer.

FOUR STAGES.

Callosamia promethea Drury. calc. 1.1 1.6 2.3 3.3, r .70
found 1.0 1.7 2.3 3.3 [1]

* W. H. Edwards, Psyche, v. 3, p. 159.
A. K. Dimmock, Psyche, v. 5, p. 28.